

REMARKS

Reconsideration and allowance of the subject application are respectfully requested.

Upon entry of this Amendment, claims 1-14 are pending in the application. In response to the Office Action (Paper No. 5), Applicant respectfully submits that the pending claims define patentable subject matter.

Claim 10 is objected to as being dependent upon a rejected base claim. By this Amendment, Applicant has rewritten claim 10 in independent form in order to place claim 10 in condition for allowance as indicated by the Examiner.

I. Preliminary Matters

The Examiner has objected to the drawings because the specification does not contain a brief description of Figures 4A-4G. However, Applicant notes the specification was amended in the Preliminary Amendment filed along with the present application on December 27, 2000 in order to provide a brief description of Figures 4A-4G. Accordingly, the Examiner is requested to remove the objection to the drawings.

Claim 14 is rejected under 35 U.S.C. § 112, second paragraph, as being indefinite because the Examiner asserts that the phrase "a reflection layer" (lines 3 and 10) is the same one claimed in claim 1. By this Amendment, Applicant has amended claim 14 to improve clarity. Accordingly, the Examiner is requested to remove the § 112, second paragraph, rejection of record.

II. Prior Art Rejections

A. Disclosure of Broer et al.

Broer et al. (U.S. Patent No. 5,808,713; hereafter “Broer”) is directed to a flat-panel picture display device comprising an optical waveguide provided with integrated polarizing means for polarizing light coupled into the optical waveguide, and a picture display panel for modulating the state of polarization of the light polarized by the optical waveguide in conformity with picture information to be displayed. As shown in Figure 1, a picture display panel 3 includes two optically transparent substrates 15, 17 made of glass or synthetic material, each provided with an ITO electrode 19, 21 and a polyimide orientation layer 23. An active layer 13 made of a liquid crystalline material is interposed between the substrates 15, 17. A first surface 25 of the picture display panel 3 is provided with an analyzer 27 and a second surface 29 opposite the first surface 25 is provided with a reflective polarizer 31.

The complete picture display panel 3 may function as an optical waveguide, or alternatively, it is possible to use only the substrate 17 as an optical waveguide, which substrate serves as the bottom plate. In that case, a layer (not shown) having a low refractive index, for example, an SiO₂ layer is provided between the substrate 17 and the active layer 13 in order that the beam component having the unwanted state of polarization can be reflected on this surface.

B. Disclosure of Ciupke et al

Ciupke et al. (U.S. Patent No. 5,461,547; hereafter “Ciupke”) discloses in Figures 1 and 2, a flat panel display lighting system wherein an internally reflecting light pipe or guide 11 is used for backlighting a liquid crystal display (LCD) 12. The light guide 11 includes one planar surface 13 and an opposite light extracting surface 14 created by facets 16 created by v-shaped

grooves 17. A light source 18 is disposed on a side surface of the light guide 11. Light is emitted from the light source in a direction generally perpendicular to the longitudinal axis 15 of the v-grooves into the end of the light guide 11, reflects off the planar surfaces and off of the facets. A reflector 27 with reflecting surface 28 is placed adjacent to the faceted surface and reflects light which escapes from this surface back into the light guide 11 and toward the surface 13. Disposed on the end of the light guide 11 is a reflector 29 which reflects light traveling through the light pipe back into the light guide 11. A diffuser or brightness enhancing film 31 receives the light emitted from the light guide 11 and diffuses the light so that light of relatively uniform intensity strikes the back of the LCD 12.

C. Disclosure of Masuda et al.

Masuda et al. (U.S. Patent No. 6,340,999; hereafter "Masuda") is directed to a reflective type LCD apparatus. As shown in Figure 1, the reflective type LCD apparatus includes a front light 1 and a reflective type liquid crystal display device 5. The front light 1 includes a light source 2, a light guide 3, and a polarization selecting section 4. The reflective type liquid crystal display device 5 includes a pair of glass substrates 5a and 5b including a liquid crystal layer 6 interposed therebetween. The reflective type liquid crystal display device 5 includes a reflector 7 on the backside of the liquid crystal layer 6.

The light guide 3 has a light introduction surface 3a and a lower surface 3b which is substantially perpendicular to the light introduction surface 3a. An upper surface 3c opposite to the lower surface 3b includes periodic concave and convex portions 3f formed at a

predetermined pitch in the shape of a prism, and each of the periodic concave and convex portions 3f includes a propagation portion 3d and a reflection portion 3e. The polarization selecting section 4 includes a polarizing plate 4a, a half-wave plate 4b and a quarter-wave plate 4c (Figure 2). The polarizing plate 4a of the polarization selecting section 4 and the lower surface 3b of the light guide 3 are optically attached together via an adhesive layer 10 so that no reflection occurs at the interface between the polarizing plate 4a and the lower surface 3b.

D. Analysis

Claims 1-9 and 11 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Broer in view of Ciupke and Masuda. Claims 12-14 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Broer in view of Ciupke and Masuda. Applicant respectfully submits that the claimed invention would not have been rendered obvious in view of the combined references.

Independent claim 1 recites, in part, “an optical path changing sheet which has a refractive index exhibiting a refractive index difference of not higher than 0.15 from a refractive index of a nearest liquid-crystal cell substrate, and which is bonded onto a back side opposite to a visual side of said liquid-crystal display panel through an adhesive layer having a refractive index exhibiting a refractive index difference of not higher than 0.20 from the refractive index of said nearest liquid-crystal cell substrate”. Applicant submits that the combined references do not teach or suggest this feature of the claimed invention.

According to the present invention, light emitted from the light source travels through the liquid crystal panel as shown in Figure 1. In order to lead the light to the optical path changing

slopes of the optical path changing sheet efficiently, it is preferable to reduce the difference in refractive index between the nearest glass substrate of the panel and the adhesive layer or the difference in the refractive index between the nearest glass substrate and the optical path changing sheet.

The Examiner maintains that Broer discloses all of the features of independent claim 1 except for “a refractive index difference of the optical path changing sheet and a nearest LCD substrate as well as a refractive index difference of an adhesive layer ... and the nearest LCD substrate”, which the Examiner contends is disclosed by Masuda. In particular, the Examiner asserts that Masuda discloses “a refractive index difference of the optical path changing sheet ($n = 1.5$ for light guide) and a nearest LCD substrate ($n = 1.449$ for glass) is not higher than 0.15 as well as a refractive index difference of an adhesive layer ($n = 1.5$) and the nearest LCD substrate ($n = 1.449$ for glass) is not higher than 0.2 (or 0.1 in claim 6).” Further, the Examiner asserts that “it would have been obvious ... to form the Broer et al. device having a substrate, adhesive layer and an optical path changing sheet having a refractive index approximate to each other as shown by Masuda et al. in order to obtain a uniform illumination in an LCD device.” Applicant respectfully disagrees with the Examiner’s position.

Masuda discloses a liquid crystal display apparatus structure where the light guide 3 is separated from the LCD device 5, wherein light emitted from the light source 2 is transmitted through the whole range of the light guide 3 and emitted toward the device 5. If the light guide 3 is brought into contact with the device 5, the light emitted from the light source 2 is partially and directly leaked to the LCD device 5 which results in a loss of utilization of light used for the

$$\begin{aligned} n_{\text{glass}} &= 1.491 \\ n_{\text{adhe}} &= 1.5 \\ n_{\text{lightguide}} &= 1.49 \end{aligned}$$

display of the image. The Examiner notes that Masuda discloses that the (nearest) LCD substrate 5a is made of glass and refers to the refractive index of the LCD substrate 5a as being " $n = 1.449$ " for glass". However, Applicant respectfully submits the refractive index of glass depends of the specification of the particular glass in question. Although Masuda discloses the adhesive layer 10 has a refractive index of about 1.5 and the light guide 3 has a refractive index of about 1.49, nowhere does the reference disclose the refractive index of the LCD substrate 5a. In other words, Masuda never mentions the difference in the refractive index between the glass substrate of the panel and the adhesive layer or the difference in the refractive index between the glass substrate and the optical path changing sheet, as claimed.

$$\begin{array}{r} 1.491 \\ 1.49 \\ \hline 0.001 < 0.1 \\ 1.500 \\ 1.491 \\ \hline 0.009 < 0.20 \end{array}$$

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Similarly, Applicant submits Ciupke does not teach or suggest the claimed difference in the refractive index between the glass substrate of the panel and the adhesive layer or the claimed difference in the refractive index between the glass substrate and the optical path changing sheet.

Accordingly, Applicant respectfully submits that independent claim 1, as well as dependent claims 2-9 and 11-14, should be allowable because the applied references, alone or in combination do not teach or suggest all of the features of the claims, and (2) one ordinary skill in the would not have been motivated to modify the combined references to produce the claimed invention.

III. Conclusion

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the

AMENDMENT UNDER 37 C.F.R. § 1.111
U.S. Patent Application No. 09/748,212

Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

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